

## CLAIMS

1. A fluid treatment line for performing a continuous treatment, such as demineralizing, de-bittering, de-salting or other separation or treatment of components of a flow of fluid, wherein the treatment line comprises

a plurality of electrodialysis treatment units, said treatment units being configured for connection so as to receive a feed flow of feed fluid that is to be treated, and so as to receive a flow of concentrate fluid that is to receive material removed from the feed flow during treatment in said treatment units, each treatment unit being electrically connectable to ionically transfer said material from the flow of feed fluid into the flow of concentrate fluid

a plurality of fluid connections interconnecting said treatment units in stages along the treatment line such that feed fluid proceeds sequentially from a first stage to one or more later stages, and concentrate fluid proceeds in an opposite sense from a later stage to one or more earlier stages of the treatment line,

effectively matching characteristics of feed and concentrate in the stages to enhance said treatment of the feed fluid for production of treated product.

2. The fluid treatment line of claim 1, wherein the interconnections produce said flow of receiving fluid along a direction counter to said feed flow effective to enhance conductivity matching of said feed flow and said concentrate flow in the treatment units along the treatment line, thereby assuring stable electrical operating conditions in said units.

3. The fluid treatment line of claim 1, wherein the interconnections produce a counterflow of receiving fluid effective to enhance removal of a component from or back-diffusion of a component into the feed fluid.

4. The fluid treatment line of claim 1, wherein the interconnections produce a counterflow of receiving fluid effective to inhibit diffusive loss of a component (such as a small molecule) from the feed fluid through membranes of the treatment units.
5. The fluid treatment line of claim 1, wherein the treatment units include EDI units.
6. The fluid treatment line of claim 1, wherein the treatment units include ED units.
7. The fluid treatment line of claim 1, wherein the treatment units include one or more ED units and one or more EDI units.
8. The fluid treatment line of claim 7, wherein at least some of said ED units are in a different stage than at least some of said EDI units, and are located upstream of said EDI units in the treatment line.
9. The fluid treatment line of claim 1 or 2, wherein the treatment units are arranged in plural electrical stages that are impressed with different potentials effective to simultaneously enhance quality and flow of said feed fluid along the treatment line.
10. The fluid treatment line of claim 1 or 9, wherein the interconnections include one or more valves operable to control flow to effect reversal operation of at least some of the units.
11. The fluid treatment line of claim 1, 9 or 10, wherein the interconnections include a common feed conduit and at least one pump operable to circulate feed fluid from the common feed conduit to a stage and back to the conduit as the feed fluids moves along the treatment line.

12. The fluid treatment line of claim 1 or 9, wherein the interconnections include at least one pump operable to circulate concentrate fluid from a common conduit through a unit of a stage and back to the conduit as the concentrate flow proceeds in a counter direction along the treatment line.
13. The fluid treatment line of claim 1, wherein the treatment line includes at least one sensor operative to detect quality of the feed flow, and a controller operative to control a valve or pump in response thereto.
14. The fluid treatment line of claim 1 or 13, further comprising a detector operative to sense a characteristic of the concentrate and a controller responsive thereto for controlling operation of the treatment line.
15. The fluid treatment line of claim 10, further comprising a controller operative to effect a phased interchange of fluid connections between said units and a feed line during reversal operation of at least some of said units so as to increase product recovery while maintaining product quality.
16. The fluid treatment line of claim 1, 10 or 15, wherein the controller effects cleaning of cells during a reversal phase to flush accumulated material from said units.
17. The fluid treatment line of claim 16, wherein said cleaning includes a concentrated salt cleaning effective to remove biofoulant from resin surfaces in said units.
18. The fluid treatment line of claim 1, comprising a common concentrate line and at least some of said units are reversal units, said interconnections including a plurality of reversal valves operable to interchange dilute and concentrate flows of the reversal units, and wherein a controller operates to selectively effect reversal operation of a unit to carry out a cleaning regimen that backflushes accumulated foulants from cells of the unit, e.g., to the common concentrate line.

19. The fluid treatment line of claim 18, wherein the cleaning regimen operates with a salt solution above 1.0 N to clean surfaces and restore flow through cells of the unit.
20. The fluid treatment line of claim 18, wherein the cleaning regimen includes a step of recirculating salt solution through the unit during hydraulic reversal, optionally at one or more extremes of pH.
21. The fluid treatment line of claim 18, wherein the cleaning regimen includes a step of recirculating fluid during reversal to break up and remove surface film, and flushing the removed film to the common concentrate line or to waste.
22. A process of for treating a biological feed stream, such process including the steps of
- treating the feed to remove components thereof by passing the feed fluid through electrodialysis units
  - wherein the electrodialysis units include a stage of filled-cell electrodialysis (EDI) units, and the process is carried out to
    - remove first components of the feed by normal operation of at least one of said units to transfer the first components into a concentrate stream while capturing second components in or on exchange resin, and
    - release or backflush second components during a reversal or cleaning mode of operation of said at least one unit.
23. The process of claim 22, wherein an EDI unit has cells with a first exchange resin packing at an upstream end of the cells and a second resin packing at a downstream portion of the cells
- the first and second packings being different, and
  - the first packing conditioning flow ahead of the second packing by defouling, acidifying or the like.

24. The process of claim 22, wherein the process is performed by means of a thick cell store and release EDI reversal unit.

25. A treatment system comprising a plurality of electrodialysis units arranged in stages to each receive a feed flow to be treated and a concentrate flow, wherein at least one stage includes one or more filled-cell electrodialysis (EDI) units, and said feed flow proceeds through the stages in an order opposite to that of the concentrate flow.

26. The treatment system of claim 25 arranged to balance a characteristic of the feed and concentrate flows in said units.

27. The treatment system of claim 26, wherein the characteristic includes one or more of the characteristics of electrical conductance or resistance, fluid pressure and concentration of a fluid component.